

NATURAL RESOURCES CONSERVATION SERVICE
PACIFIC BASIN AREA
CONSERVATION PRACTICE STANDARD

WASTE TREATMENT LAGOON

(Number)
CODE 359

DEFINITION

An impoundment made by excavation or earth-fill for biological treatment of animal or other agricultural waste.

PURPOSE

To biologically treat organic waste, reduce pollution, and protect the environment.

CONDITIONS WHERE PRACTICE APPLIES

The practice applies where all of the following occur:

1. Waste generated by agricultural production or processing needs treatment;
2. A lagoon can be located near the source of the waste and a minimum of 91 m (300 ft) from a neighboring residence or public area;
3. Soils are suitable for retaining the waste or can be sealed; and,
4. A water supply is adequate to fill the lagoon about half full before operation and to maintain the design depth when the lagoon becomes fully operational.

CRITERIA

DESIGN

General - Design shall be in accordance with guidance provided in the Agricultural Waste Management Field Handbook (AWMFH).

Soil and Foundation. Locate the lagoon on soils of slow to moderate permeability or on soils that can seal through sedimentation and biological action. Avoid gravelly soils and shallow soils over fractured or cavernous rock.

If self-sealing is not probable, the lagoon shall be sealed by mechanical treatment or by the use of an impermeable membrane. A soil

investigation to at least 0.6 m (2 ft) beneath the anticipated bottom of the lagoon shall be performed to determine the suitability of the soil. Test pit logs shall be kept and all logging shall be in accordance with the Unified Soil Classification System. Use of the USDA NRCS soil survey shall be limited to planning activities.

Waste production. Waste treatment lagoons are designed on the basis of 5 day biochemical oxygen demand (BOD₅) or volatile solids (VS) loading. Design loading shall be based on the maximum weight of animals using the lagoon and on other waste introduced. Information on waste production is provided in Chapter 4 of the Agricultural Waste Management Field Handbook (AWMFH). Reliable local determinations should be used if available.

Loadings. Anaerobic waste treatment lagoons are designed on the basis of daily VS loading per fixed volume of lagoon. Maximum loading shall be 192 Kg VS/M³/day (0.2 lb VS/1,000 ft³/day) or according to local regulatory requirements, whichever is more stringent. If a high degree of odor control is necessary, loading rates should be decreased.

Naturally aerobic lagoons are designed on the basis of daily BOD₅ loading per hectare (acre) of lagoon surface. Maximum allowable loading shall be 67 Kg BOD₅/Ha/day (60 lb BOD₅/acre/day) or according to local regulatory requirements, whichever is more stringent.

Volume. The maximum operating level shall be set to provide the designed loading plus a volume sufficient to store the following:

1. Manure and waste water;
2. Normal precipitation less evaporation on lagoon surface;

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3. Solids accumulation for the period between solids or sludge removal;
4. Accumulated between periods of draw down; and,
5. For the period between solids or sludge removal.

Mechanically aerated lagoons are designed on the basis of BOD5 or ultimate BOD loading and on the basis of the equipment manufacturer's performance data for oxygen transfer and mixing. If used for odor control, aeration equipment shall provide a minimum of 0.5 kg (1 lb) of oxygen for each half kilogram (pound) of BOD 5 contributed daily. For complete treatment, refer to the design procedures provided in the Agricultural Waste Management Field Handbook (AWMFH).

The maximum operating level shall be sufficient distance below any automatic outflow device, pipe, or emergency spillway to provide storage for the 25 year, 24-hour precipitation on the lagoon surface. The maximum operating level should be marked with an appropriate staff gage set in the lagoon or by other means to indicate when drawdown is needed.

The minimum operating level after drawdown should normally be that level needed for the design loading except when the lagoon is in drawdown to permit sludge removal or addition of dilution water.

Depth. The minimum depth of liquid shall be 1.8 m (6 ft) for mechanically aerated and anaerobic lagoons, and 0.61 m (2 ft) for aerobic lagoons. If subsurface conditions prevent practical construction of anaerobic lagoons to a depth of 1.8 m (6 ft), a lesser depth may be used if volume requirements are met. The maximum depth for mechanically aerated and anaerobic lagoons is dictated by the site and the equipment. The maximum operating depth for aerobic lagoons shall be 1.5 m (5 ft).

Bottom and Edges. The bottom of aerobic lagoons shall be approximately level. The edges of all lagoons below the planned waterline shall be constructed as steep as

soil conditions permit to reduce areas of shallow water and to inhibit weed growth.

Earth Embankment. Embankments are limited to an effective height of 10.7 m (35 ft) or less and to hazard class (a). The design height of the embankment shall be increased by the amount needed to insure that the design top elevation is maintained after settlement. This increase shall not be less than 5 percent. The minimum top width shall be as shown below.

Total height of embankment – (M, Ft)	Top width – (M, Ft)
3.1 or less 10 or less	1.8, 6
3.4-4.3, 11 –14	2.4, 3
4.6-5.8, 15 - 19	3.1, 10
6.1 -7.3, 20 - 24	3.7, 12
7.6-10.4, 25 - 34	4.3, 14
10.7, 35	4.6, 15

For this standard, the maximum effective height of the dam is 10.7 m (35 ft). The combined side slopes of the settled embankment shall not be less than 5 horizontal to 1 vertical. The minimum elevation of the top of the settled embankment shall be 0.3 m (0 ft) above the maximum design water surface in the lagoon.

Inlet. If freezing is not a problem, an open inlet, such as a concrete channel, may be used. If freezing is a problem, the inlet shall consist of a pipe having a minimum diameter of 15 cm (6 in) and a minimum slope of 1 percent, except that a minimum diameter of 10 cm (4 in) may be used for milking center waste. The inlet pipe should terminate a sufficient distance from the shoreline to insure good distribution. It should be far enough below the surface to avoid freezing or be provided with other protective measures. Access should be provided to the pipe for rodding in case of blockage. A water-sealed trap and vent or a similar device shall be provided on pipelines from enclosed buildings that discharge to enclosed settling tanks or beneath the lagoon surface. Such a device helps to prevent gases from entering the building. Inlet lines shall be made of materials that will not separate at the joints, that will be

watertight, and that can withstand sunlight, weather, and earth and traffic loading.

Outlet. Waste treatment lagoons shall not discharge to surface waters unless the owner determines through the state regulatory agency that such discharge will not contravene established water quality standards. Lagoons having a maximum design liquid level of 0.91 m (3 ft) or more above natural ground shall be provided with an emergency spillway or an overflow pipe to prevent overtopping. The crest of the emergency spillway or the invert of the emergency overflow pipe shall be at least 0.31 m (1 ft) below the top of the settled embankment. The emergency spillway, if used, shall have a minimum bottom width of 1.2 m (4 ft). The emergency overflow pipe, if used, shall have a minimum diameter of 15 cm (6 in).

Solids Removal. To reduce sludge buildup, remove solids from waste of animals, such as dairy cattle, fed high roughage rations. A solids trap or a separator may be provided between the waste sources and the lagoon. This may be a concrete or earth structure that can be emptied periodically. A minimum of 7 days storage should be provided, based on a minimum of 23 L (6 gal)/day/horse or cow and 3.8 L (1 gal)/day/sheep or hog, except that a minimum of 3 days storage may be provided for milking center waste. If earth structures are used, a minimum of two should be planned so that one can be dried and cleaned while the other is functioning.

Protection. The lagoon shall be fenced and warning signs posted to prevent children and others from using it for purposes other than intended. The embankment and surrounding areas will be vegetated to control erosion.

Vegetative screens or other methods should be used to shield the lagoon from public view and to improve visual conditions.

PLANNING CONSIDERATIONS

Types. Waste treatment lagoons are of three general types-anaerobic, naturally aerobic, and mechanically aerated. Anaerobic lagoons require less surface area than naturally aerobic lagoons but may give off odors.

Naturally aerobic lagoons are relatively odor free. Mechanically aerated lagoons are comparable in size to anaerobic lagoons and are generally odor free, but they require energy for aeration.

Location. The lagoon should be located near the source of waste and as far from neighboring dwellings as practicable, a minimum distance of 91 m (300 ft). If possible, locate the lagoon where prevailing winds will carry odors away from residences and public areas. Runoff from outside drainage areas should be excluded from the lagoon. The lagoon shall not be located on a flood plain unless it is protected from inundation or damage by a 25-year frequency flood event.

WATER QUANTITY

Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.

Variability of the practice's effects caused by seasonal or climatic conditions.

Effects of the demand of operation and maintenance on the water supply.

WATER QUALITY

Effects on erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances carried by runoff and seepage. Effects of nutrients on surface and ground water quality, particularly the on site water supply for humans and livestock consumption. 3. Effects on the visual quality of on site and downstream water resources. 4. Short term and construction related effects on the quality of downstream water. 5. Effects on the movement of dissolved substances below the root zone toward ground water. 6. The effects on wetlands and water related wildlife habitats.

PLANS AND SPECIFICATIONS

Plans and specifications for installing waste treatment lagoons shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

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Preliminary to developing design and construction plans, survey data must be obtained. Such data shall include sufficient points to develop and show the entire lagoon in plan view, profile, cross sections, locate physical features (roads, trees, livestock facilities, loading and unloading features, etc.) and location of spoil placement. Survey will be in accordance with Engineering Field Handbook (EFH) Chapter 1 and Technical Release 62. Geologic information (test pit logs) shall be shown on the drawings, and test pit locations shall be shown on the plan view of the design.

Construction plans shall include a plan view drawn to scale, facility sectional views and spoil placement requirements as a minimum. If additional conservation practices are to be constructed in conjunction with Waste Treatment Lagoon, e.g. addressing water management and water quality concerns, the information necessary to construct these practices will also be conveyed on the plans. Development of plans will be guided by EFH - Chapter 5 and policy carried in the National Engineering Manual (NEM).

Incidental information necessary to construct the job will need to be either communicated in the construction specifications or carried on the construction drawings in the form of construction notes.

As-Built-Plans. As-Built-Plans, when required by the approving individual, shall reflect all significant changes in alignment, cross section, structure location, etc. It is expected that all changes will be with prior consent of the individual approving the design. If there were no changes, the original drawings shall be marked, "As-Built."

OPERATION AND MAINTENANCE

A written Operation and Maintenance plan shall be developed for the Waste Treatment Lagoon. It shall be site specific and may include the operation and maintenance requirements for other conservation practices addressing the resource.

The operator should be made aware of the management requirements associated with the practice early in the assistance process

and should be providing input into the planning, preliminary, and final design stages.